

Application No. 10/600,102

2

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

- 1 1. (currently amended) A device for use with a piano comprising:
  - 2 a housing configured to reside above a minor portion of a
  - 3 keyboard of said piano, said housing being dimensioned to be non-intrusive
  - 4 with respect to manipulations of said keyboard by a user of said piano; [[and]]
  - 5 an array of signal generators mounted to said housing to
  - 6 monitor activities of a plurality of keys of said keyboard, each said signal
  - 7 generator being operatively associated with one of said keys and including
  - 8 at least one light emitting device positioned to direct light so as to directly
  - 9 impinge said associated key when said associated key is in a rest position,
  - 10 each said signal generator further including at least one optical receiver
  - 11 positioned with respect to said associated key and said light emitting device
  - 12 of said each signal generator to detect movement of said associated key
  - 13 relative to said rest position; and
  - 14 means for sensing positions of pedals of said piano and
  - 15 generating electrical signals indicative of displacements of said pedals;
  - 16 wherein said keys remain free from mechanical contact with
  - 17 structure for enabling said signal generators to monitor said activities of said
  - 18 keys.

Application No. 10/600,102

3

1 2. (original) The device of claim 1 wherein said array includes first signal  
2 generators dedicated to white keys of said keyboard and includes second  
3 signal generators dedicated to black keys of said keyboard, wherein:

4 (a) said at least one light emitting device and said at least one  
5 optical receiver of each said first signal generator are cooperative to provide  
6 an output signal that is indicative of intensity of light reflected from said white  
7 key to which said first signal generator is dedicated; and

8 (b) said at least one light emitting device and said at least one  
9 optical receiver of each said second signal generator are cooperative to  
10 provide an output signal that is indicative of light blocked by said black key to  
11 which said second signal generator is dedicated.

1 3. (original) The device of claim 2 wherein each said second signal generator  
2 includes an optical member cooperative with said at least one optical receiver  
3 to provide an expanded field of view for detecting light from said at least one  
4 light emitting device.

1 4. (original) The device of claim 3 wherein said optical member is a  
2 cylindrical lens, said at least one light emitting device being a single light  
3 emitting diode (LED).

1 5. (original) The device of claim 2 wherein each said second signal generator  
2 includes a plurality of said light emitting devices and a plurality of said optical  
3 receivers.

1 6. (cancelled)

Application No. 10/600,102

4

1 7. (original) The device of ~~claim 6~~ claim 1 wherein said means for sensing  
2 includes coils having a one-to-one correspondence with said pedals, said  
3 coils being positioned relative to said pedals to have inductances which vary  
4 with said displacements of said pedals.

1 8. (original) The device of claim 7 wherein said means for sensing further  
2 includes a wireless transmitter enabled to transmit said electrical signals that  
3 are indicative of displacements of said pedals.

1 9. (original) The device of claim 1 further comprising computer processing  
2 connected to receive output signals from said array of signal generators and  
3 to calculate velocity data for displacements of each said key, said velocity  
4 data being based upon sequencing within said output signals.

1 10. (cancelled)

Application No. 10/600,102

5

1 11. (original) A device for use with a piano comprising:  
2 a housing located at a back region of a keyboard of said piano  
3 so as to be adjacent to a plurality of white keys and to extend between black  
4 keys without influencing movement of said white and black keys when said  
5 keyboard is in use;  
6 a set of first light emitters disposed to project light from said  
7 housing onto said white keys;  
8 a set of first photo receivers positioned to detect portions of said  
9 light reflected by said white keys, said first photo receivers being enabled to  
10 generate electrical outputs representative of intensities of said detected  
11 portions of light;  
12 a set of second light emitters disposed to project light from said  
13 housing onto said black keys when said black keys are at rest, while allowing  
14 said light to pass above said black keys when said black keys are lowered;  
15 a set of second photo receivers positioned to detect said light  
16 passing above said black keys, said second photo receivers being enabled to  
17 generate electrical outputs representative of intensities of said light; and  
18 computational processing coupled to said first and second photo  
19 receivers to receive said electrical outputs, said computational processing  
20 being enabled to determine position and velocity data for said white and black  
21 keys on a basis of said electrical outputs.

1 12. (original) The device of claim 11 further comprising piano pedal sensors  
2 located to generate position information that is specific to pedals of said  
3 piano, said computational processing being configured to form signals  
4 compatible with an external apparatus using a Musical Instrument Digital  
5 Interface (MIDI) format.

Application No. 10/600,102

6

1 13. (original) The device of claim 11 further comprising indicators assigned  
2 to said white and black keys, said indicators being connected to said housing  
3 to be visible by a user of said piano, said computational processing being configured  
4 to transmit signals to said indicators in predetermined sequences for  
5 prompting said user in manipulating said white and black keys.

1 14. (original) A method of non-intrusively detecting manipulations of a  
2 keyboard comprising:  
3 monitoring reflected light which is reflected by individual white  
4 keys of said keyboard in order to distinguish times in which said white keys  
5 are at rest from times in which said white keys are displaced;  
6 monitoring unblocked light which is unblocked by individual  
7 black keys of said keyboard in order to distinguish times in which said black  
8 keys are at rest from times in which said black keys are displaced; and  
9 determining position and velocity data for said individual white  
10 and black keys on a basis of variations in intensities of said reflected and  
11 unblocked light.

1 15. (original) The method of claim 14 wherein, for each said white key,  
2 monitoring said reflected light includes projecting a first light beam to impinge  
3 said white key and generating a signal indicative of a portion of said first light  
4 beam reflected by said white key.

1 16. (original) The method of claim 15 wherein, for each said black key,  
2 monitoring said unblocked light includes projecting a second light beam to  
3 impinge said black key when said black key is in a rest position and  
4 generating a signal indicative of a portion of said second light beam which  
5 propagates to at least one aligned photo receiver.

Application No. 10/600,102

7

1 17. (original) The method of claim 16 wherein monitoring said unblocked  
2 light further includes assigning a plurality of said aligned photo receivers to  
3 each said black key, so as to provide a wider field of view in generating said  
4 signal.

1 18. (original) The method of claim 14 further comprising using electronic  
2 monitoring to sense mechanical manipulations of pedals of said piano, said  
3 steps of monitoring and electronic monitoring being executed without  
4 mechanically affecting said pedals and said white and black keys.

1 19. (original) The method of claim 18 wherein using electronic monitoring to  
2 sense said mechanical manipulations includes positioning a coil adjacent to  
3 each said pedal and sensing inductances of said coils.

1 20. (original) The method of claim 19 wherein said steps of electronic  
2 monitoring and determining position and velocity data contribute to generating  
3 MIDI-compatible signals representative of movements of said pedals and said  
4 white and black keys.

Application No. 10/600,102

8

1 21. (new) A device for use with a piano comprising:  
2 a housing configured to reside above a minor portion of a  
3 keyboard of said piano, said housing being dimensioned to be non-intrusive  
4 with respect to manipulations of said keyboard by a user of said piano;  
5 an array of signal generators mounted to said housing to monitor  
6 activities of a plurality of keys of said keyboard, each said signal generator  
7 being operatively associated with one of said keys and including at least one  
8 light emitting device positioned to direct light so as to directly impinge said  
9 associated key when said associated key is in a rest position, each said signal  
10 generator further including at least one optical receiver positioned with respect  
11 to said associated key and said light emitting device of said each signal  
12 generator to detect movement of said associated key relative to said rest  
13 position; and  
14 a flash detector configured to detect light flashes in an area of  
15 said piano and to momentarily inhibit data from said signal generators as a  
16 response thereto;  
17 wherein said keys remain free from mechanical contact with  
18 structure for enabling said signal generators to monitor said activities of said  
19 keys.